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Science Response 2014/021

Newfoundland and Labrador Region

UPDATE OF STOCK STATUS INDICATORS FOR NORTHERN SHRIMP, *Pandalus borealis*, IN SHRIMP FISHING AREAS 4, 5 AND 6

Context

The Zonal Peer Review (ZPR) for Northern Shrimp (*Pandalus borealis*) in Shrimp Fishing Areas (SFAs) 2-6 takes place biennially, in odd numbered years. In even years, updates on the key indices of the Precautionary Approach (PA) framework for Northern Shrimp in shrimp fishing areas (SFAs) 4, 5 and 6 are requested by Fisheries and Oceans Canada (DFO) Resource Management in to inform management considerations.

This Science Response Report results from the Science Response Process of February 2014 for the Update of Stock Status Indicators for Northern Shrimp, *Pandalus borealis*, in SFAs 4, 5 and 6. The last full assessment of Divisions 2G-3K (SFAs 4-6) Northern Shrimp took place at the February 18-20, 2013 zonal peer review. Science Advisory Report 2013/012 (DFO 2013) was published as a result of the zonal peer review.

Background

Stock status indicators were evaluated based on trends in *Pandalus borealis* catch, fishable biomass and female spawning stock biomass (SSB) indices from DFO fall multi-species bottom trawl surveys in 2HJ3K and a joint Northern Shrimp Research Foundation (NSRF)-DFO summer shrimp survey in 2G and also on the exploitation rate index calculated using catch and the fishable biomass index.

The Integrated Fisheries Management Plan (IFMP) PA framework was applied using an Upper Stock Reference (USR = 80 % of the geometric mean of female SSB over a productive period) and a Limit Reference Point (LR = 30 % of the geometric mean of female SSB over a productive period) superimposed upon the exploitation rate trajectory over time. Due to differences in survey history, the respective productive time periods were thought to be 1996 -2003 for SFA 6, 1996 -2001 for SFA 5 and 2005 -09 for SFA 4.

Analysis and Response

Indicators of the Stock Status

SFA 6 (Hawke Channel and NAFO Division 3K)

Fishery

The total allowable catch (TAC) in SFA 6 was first set at 11,050 t in 1994. In 2003, the fishery season was changed from a calendar year to a fiscal year, leading to a 15 month season with an 85,585 t TAC. The TAC gradually increased to a high of 85,725 t in 2008/09 and 2009/10. There were TAC reductions in 2010/11 and 2011/12, after which resource status improved and the TAC was increased to 60,245 t for the 2012/13 and 2013/14 fishing seasons (Figure 1). The preliminary catch for the 2013/14 fishing season was 51,855 t, 86 % of the TAC, as of 14 February, 2014. It is anticipated that the 2013/14 TAC will be taken.

Biomass

The fishable biomass index for 2013 was 212,000 t and the female SSB index was 139,000 t (Figures 2 and 3). These represent declines of 33 % and 26 %, respectively, from 2012. Both indices declined since 2011 and are at the lowest levels in each time series.

Exploitation

The exploitation rate index varied around 15 % from 1997 to 2013/14, with the preliminary 2013/14 index at 16 % (Figure 4). This estimate will increase to 19 % if the 60,245 t TAC is fully taken.

Current Outlook

Female SSB, at its lowest level in the time series, was assessed to be slightly below the midpoint of the cautious zone within the IFMP PA Framework (Figure 5). If the TAC of 60,245 t is maintained and taken, the exploitation rate will increase to 28 % in 2014/15.

SFA 5 (Hopedale and Cartwright Channels)*Fishery*

The TAC doubled from 7,650t during 1994-96 to 15,300 t during 1997 -2002. In 2003, the management year changed from a calendar to a fiscal one, hence the management year was 15 months long with a TAC of 33,087 t. The TAC remained the same, at 23,300 t, from 2003/04 to 2013/14. The preliminary catch for the 2013/14 fishing season was 20,953 t, 90 % of the TAC, as of 14 February, 2014 (Figure 6). It is anticipated that the 2013/14 TAC will be taken.

Biomass

The fishable biomass index for 2013 was 76,000 t and the female SSB index was 44,000 t (Figures 7 and 8). These represent decreases of 48 % and 30 %, respectively, from 2012. Both indices are at the levels experienced before the year 2000.

Exploitation

The exploitation rate index varied without trend around 15 % from 1997 to 2013/14, with the preliminary 2013/14 index at 14 % (Figure 9). This estimate will increase to 16 % if the 23,300 t TAC is fully taken.

Current Outlook

Female SSB was assessed to be in the healthy zone within the IFMP PA Framework, with a 33 % chance of being in the cautious zone (Figure 10). If the TAC of 23,300 t is maintained and taken for 2014/15, the exploitation rate will increase to 31 % in 2014/15.

SFA 4 (NAFO Division 2G)*Fishery*

The TAC increased from 2,580 t in 1989 to 5,200 t in 1995 and then to 8,320 t in 1998. In 1998 a portion of the TAC was allocated to south of 60°N to promote spatial expansion of the fishery, a restriction that was removed in 2009/10. In 2003, the management year changed from a calendar to a fiscal year hence there was a 15 month management period with a TAC of 13,122 t. The TAC was set at 11,320 t in 2008/09, increased to 13,018 t in 2012/13 and was further increased to 14,971 t in 2013/14. The preliminary catch for the 2013/14 fishing season was 13,918 t, 93 % of the TAC, as of 14 February, 2014 (Figure 11). It is anticipated that the 2013/14 TAC will be taken.

Biomass

The fishable biomass index for 2013 was 151,000 t and the female SSB index was 94,000 t (Figures 12 and 13). These represent decreases of 21 % and 14 %, respectively, from 2012. Both indices are at comparable levels to those of previous years.

Exploitation

The exploitation rate index has varied between 6 % and 9 % since 2007/08, with the preliminary 2013/14 index at 9 % (Figure 14). This estimate will increase to 10 % if the 14,971 t TAC is fully taken.

Current Outlook

Female SSB was assessed to be in the healthy zone within the IFMP PA Framework (Figure 15) with a 10 % chance of being in the cautious zone in 2013/14.

Conclusions

SFA 6 (Hawke Channel and NAFO Division 3K)

- The resource is currently in the cautious zone, well below last year's point in the cautious zone.
- Biomass indices (fishable and female SSB) are at all-time lows.
- The exploitation rate index, based on maintaining and taking the current TAC, will be 28 % in 2014/15. This is well above any previous estimates for this resource.

SFA 5 (Hopedale and Cartwright Channels)

- The resource is currently in the healthy zone with a 33 % chance of being in the cautious zone.
- Biomass indices (fishable and female SSB) have recently decreased to the levels of pre-2000.
- The exploitation rate index, based on maintaining and taking the current TAC, will be 31 % in 2014/15. This is well above any previous estimates for this resource.

SFA 4 (NAFO Division 2G)

- The resource is currently in the healthy zone with a 10 % chance of being in the cautious zone.
- Biomass indices (fishable and female SSB) have changed little since 2008.
- The exploitation rate index for 2013/14, based on taking the current TAC, will be 10 %.

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February 24, 2014

Sources of information

This Science Response Report results from the Science Response Process of February, 2014 for the Update of Stock Status Indicators for Northern Shrimp (*Pandalus borealis*) in SFAs 4, 5 and 6.

DFO. 2007a. Assessment Framework for Northern Shrimp (*Pandalus borealis*) off Labrador and the northeastern coast of Newfoundland; 28-30 May 2007. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2007/034.

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Appendix 1: Figures

SFA 6 (Hawke Channel and NAFO Division 3K)

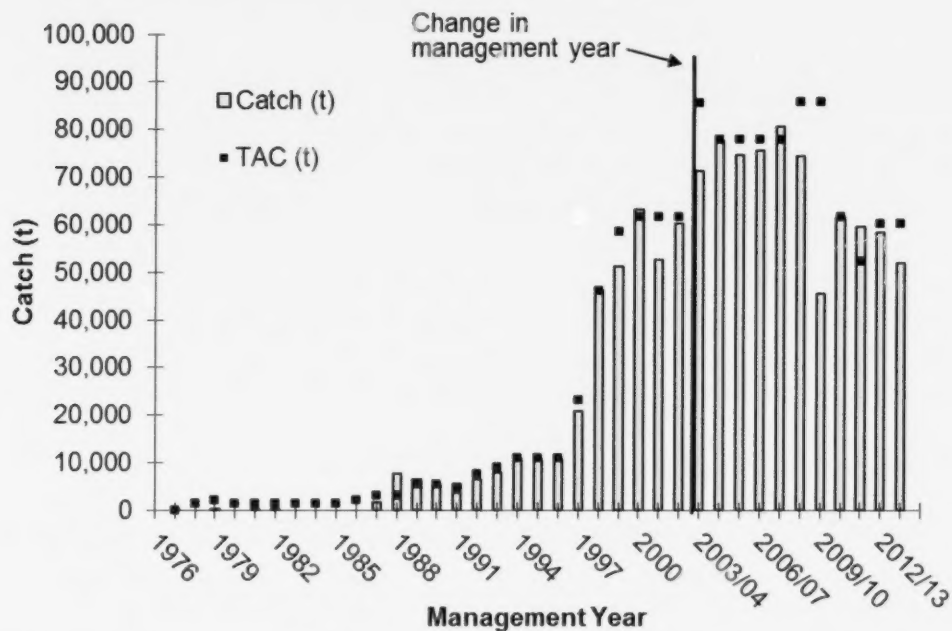


Figure 1. SFA 6 historical Northern Shrimp catches and TACs for the period 1976 – 2013/14 (2013/14 catches are preliminary as of February 14). In 2003 the management year changed from a calendar year to a fiscal year.

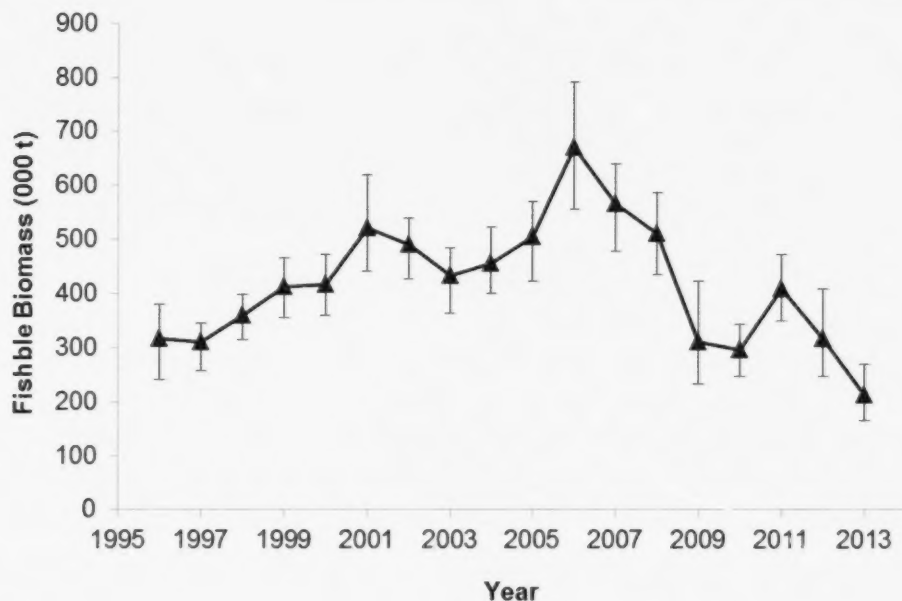


Figure 2. SFA 6 fishable biomass index. Error bars indicate 95% confidence intervals.

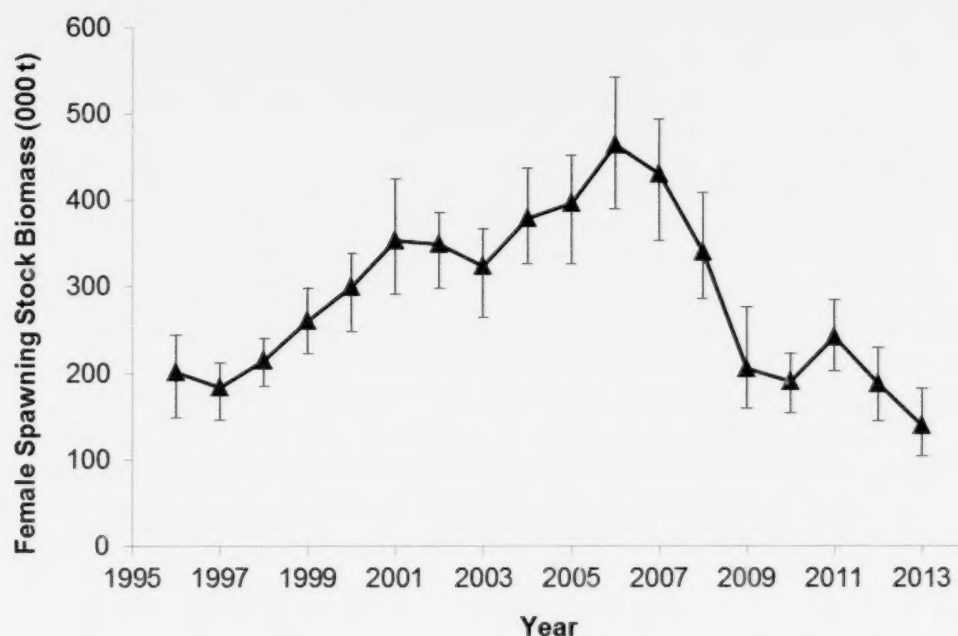


Figure 3. SFA 6 female SSB index. Error bars indicate 95% confidence intervals.

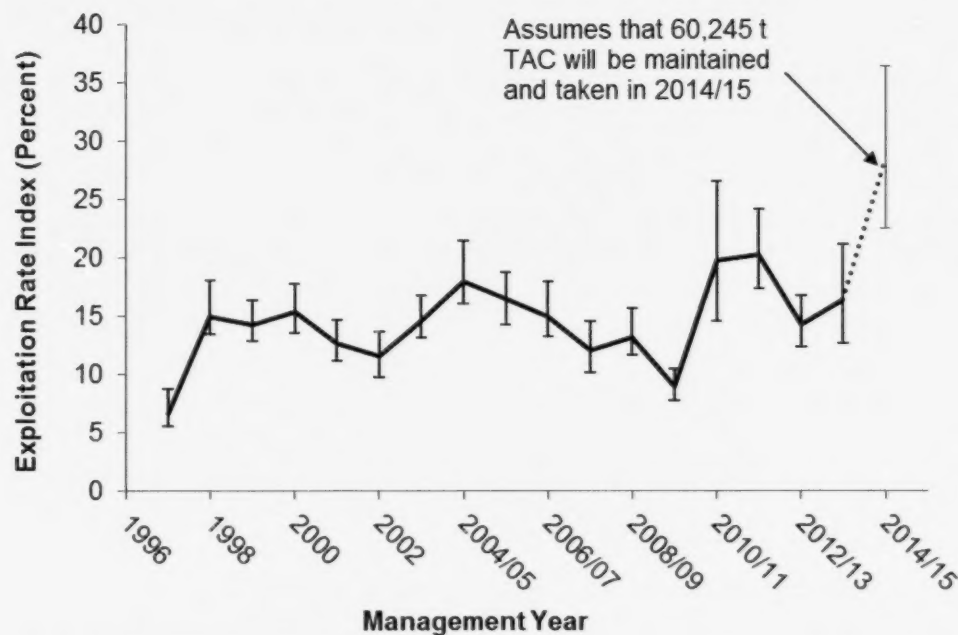


Figure 4. SFA 6 Exploitation rate index based on total catch/fishable biomass index from the previous year, expressed as a percentage. Error bars indicate 95% confidence intervals. The 2013/14 value is preliminary and the projected 2014/15 value assumes that the TAC of 60,245 t will be maintained and taken in the 2014/15 fishery.

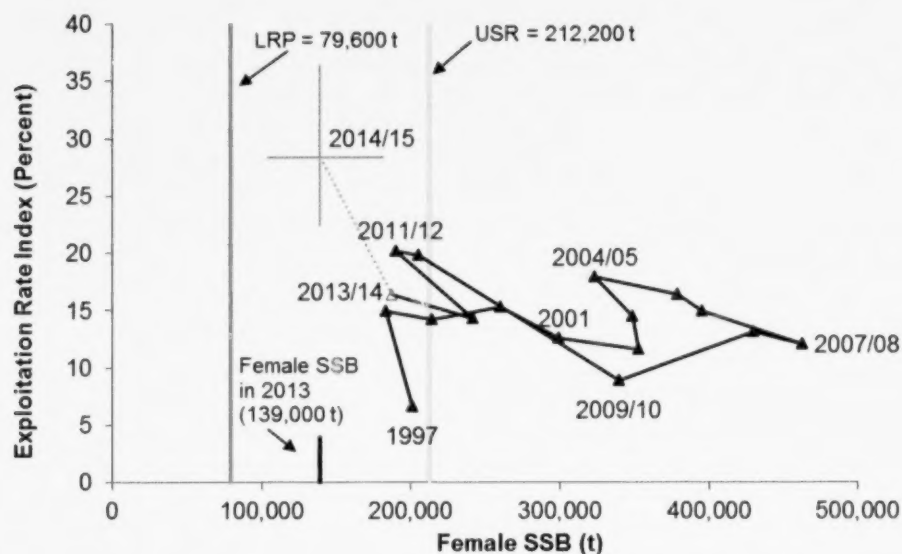


Figure 5. SFA 6 IFMP Precautionary Approach framework with trajectory of exploitation rate index versus female SSB index. Data point labels denote management year. The 2013/14 fishery was ongoing; therefore the 2013/14 point is preliminary. The red cross indicates 95% confidence intervals for the fall 2013 female SSB index (horizontal line) and projected exploitation rate (vertical line), assuming that the 60,245 t TAC is maintained and taken in the 2014/15 fishery.

SFA 5 (Hopedale and Cartwright Channels)

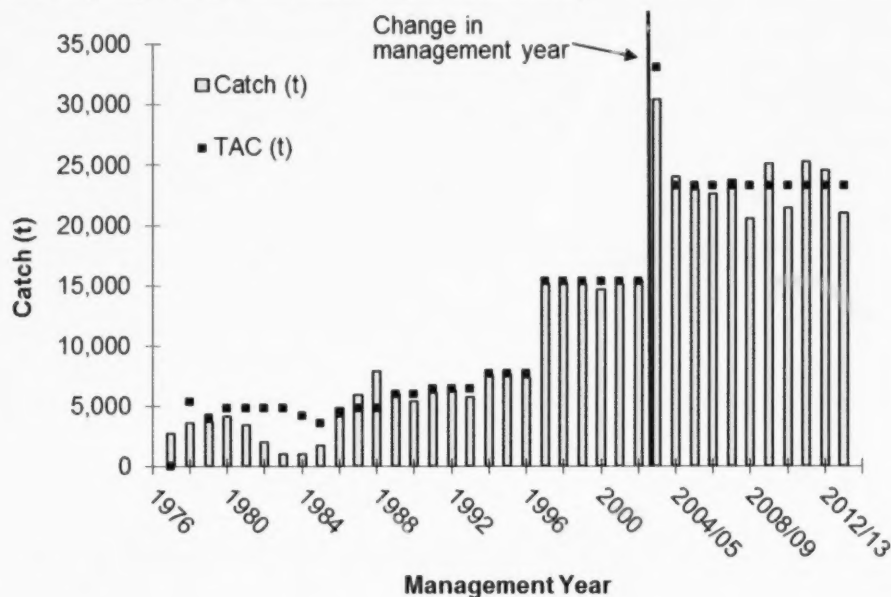


Figure 6. SFA 5 historical Northern Shrimp catches and TACs for the period 1976 – 2013/14 (2013/14 catches are preliminary as of February 14). In 2003 the management year changed from a calendar year to a fiscal year.

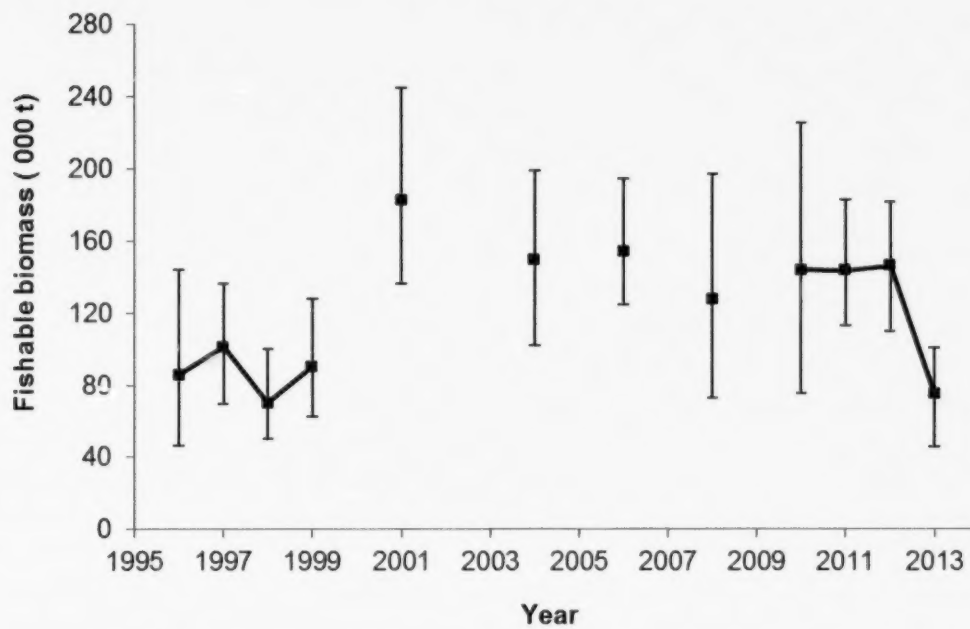


Figure 7. SFA 5 fishable biomass index. Error bars indicate 95% confidence intervals.

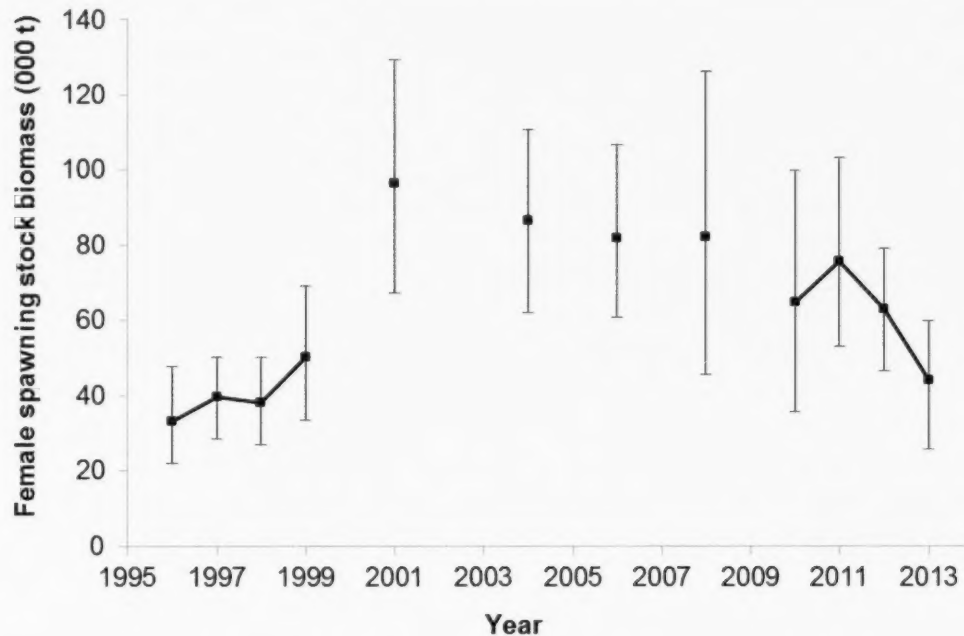


Figure 8. SFA 5 female SSB index. Error bars indicate 95% confidence intervals.

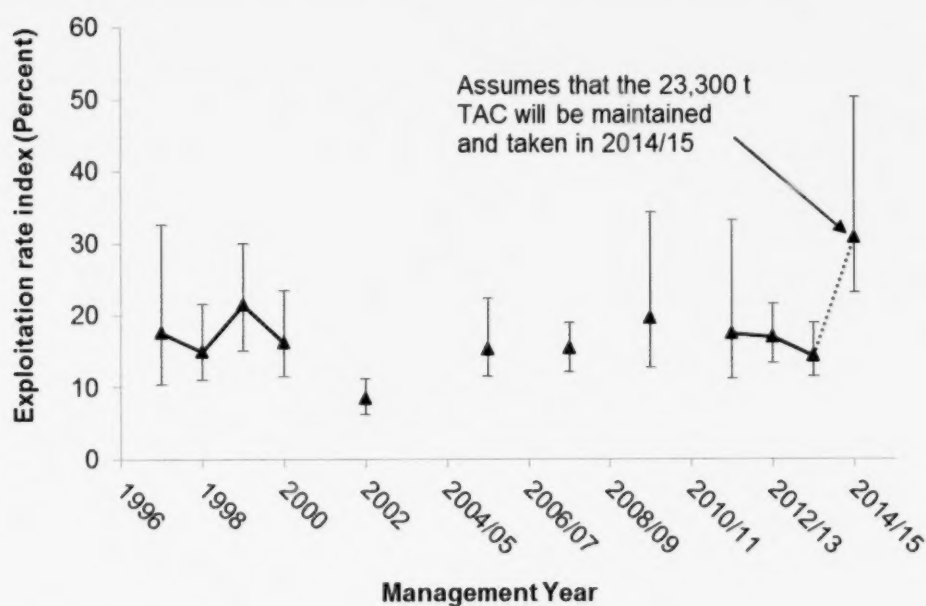


Figure 9. SFA 5 Exploitation rate index based on total catch/fishable biomass index from the previous year, expressed as a percentage. Error bars indicate 95% confidence intervals. The 2013/14 value is preliminary and the projected 2014/15 value assumes that the TAC of 23,300 t will be maintained and taken in the 2014/15 fishery.

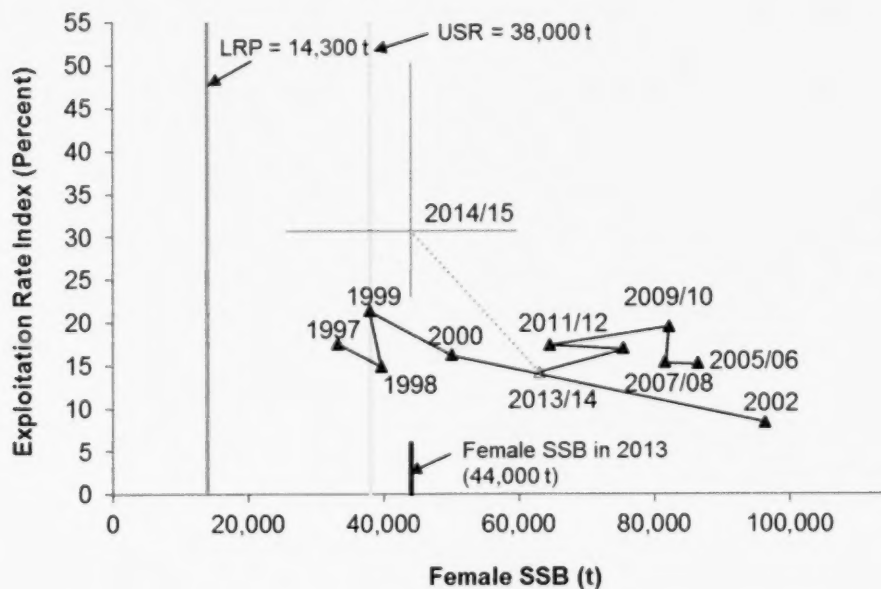


Figure 10. SFA 5 IFMP Precautionary Approach framework with trajectory of exploitation rate index versus female SSB index. Data point labels denote management year. The 2013/14 fishery was ongoing; therefore the 2013/14 point is preliminary. The red cross indicates 95% confidence intervals for the fall 2013 female SSB index (horizontal line) and projected exploitation rate (vertical line), assuming that the 23,300 t TAC is maintained and taken in the 2014/15 fishery.

SFA 4 (NAFO Division 2G)

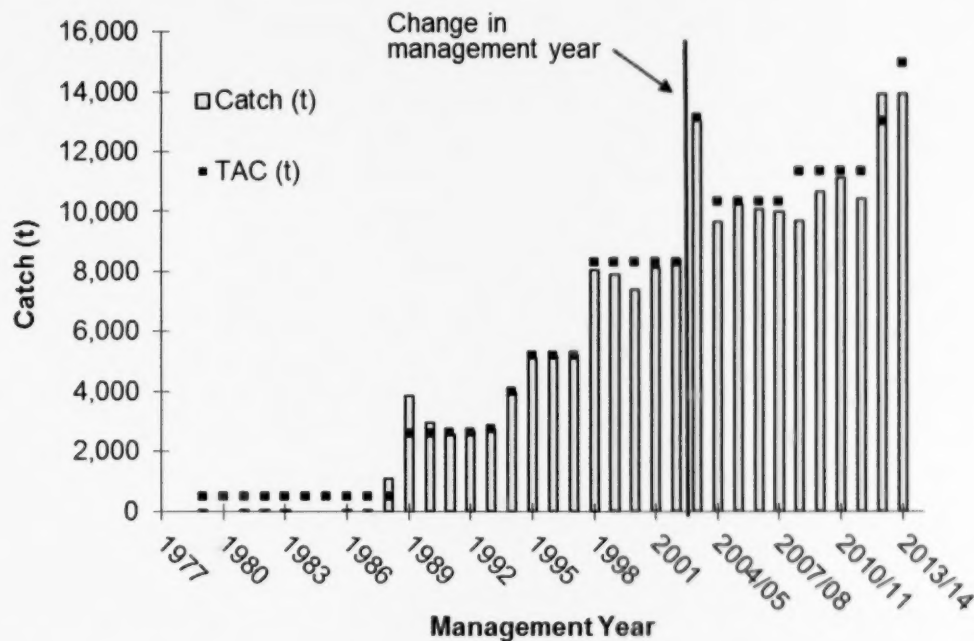


Figure 11. SFA 4 historical Northern Shrimp catches and TACs for the period 1977 – 2013/14 (2013/14 catches are preliminary as of February 14). In 2003 the management year changed from a calendar year to a fiscal year.

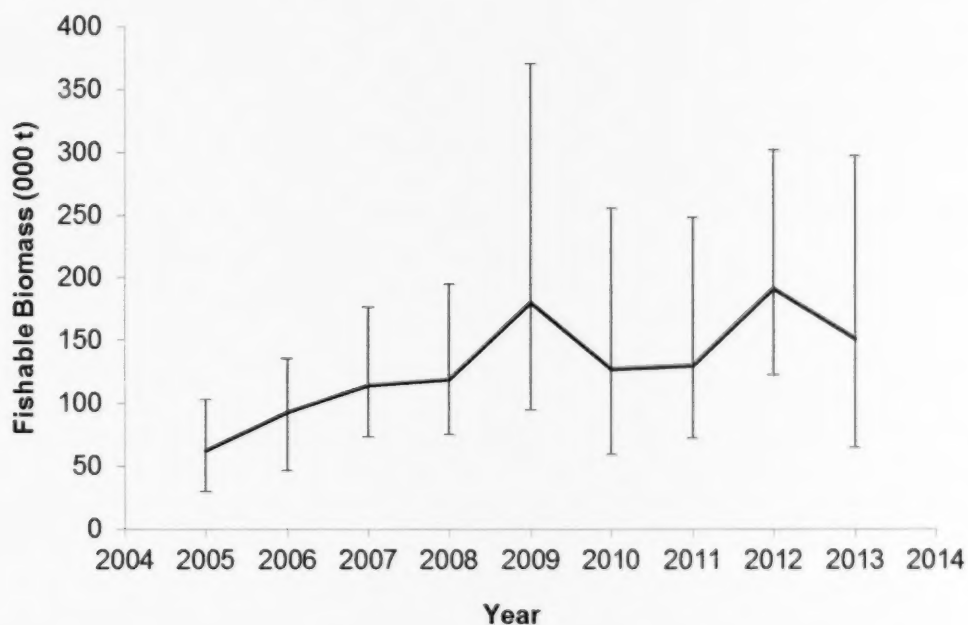


Figure 12. SFA 4 fishable biomass index. Error bars indicate 95% confidence intervals.

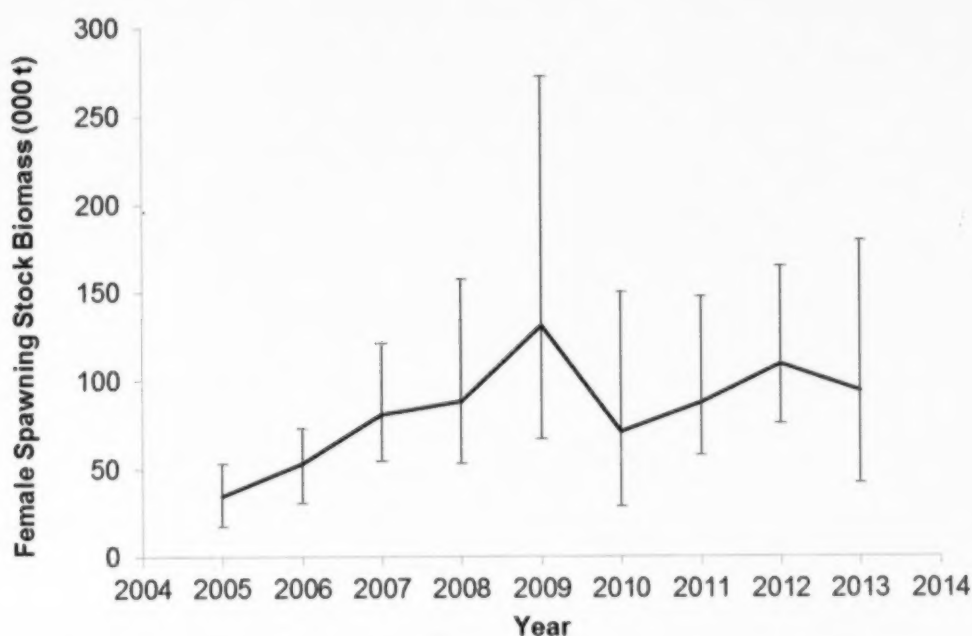


Figure 13. SFA 4 female SSB index. Error bars indicate 95% confidence intervals.

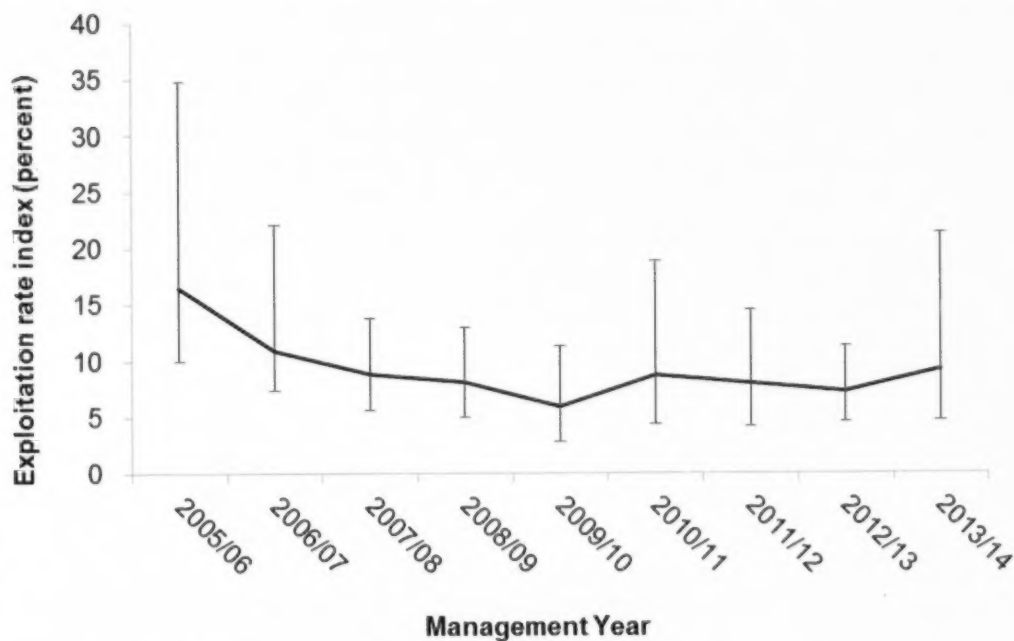


Figure 14. SFA 4 Exploitation rate index based on total catch/fishable biomass index from the same year, expressed as a percentage. Error bars indicate 95% confidence intervals. The 2013/14 value is preliminary.

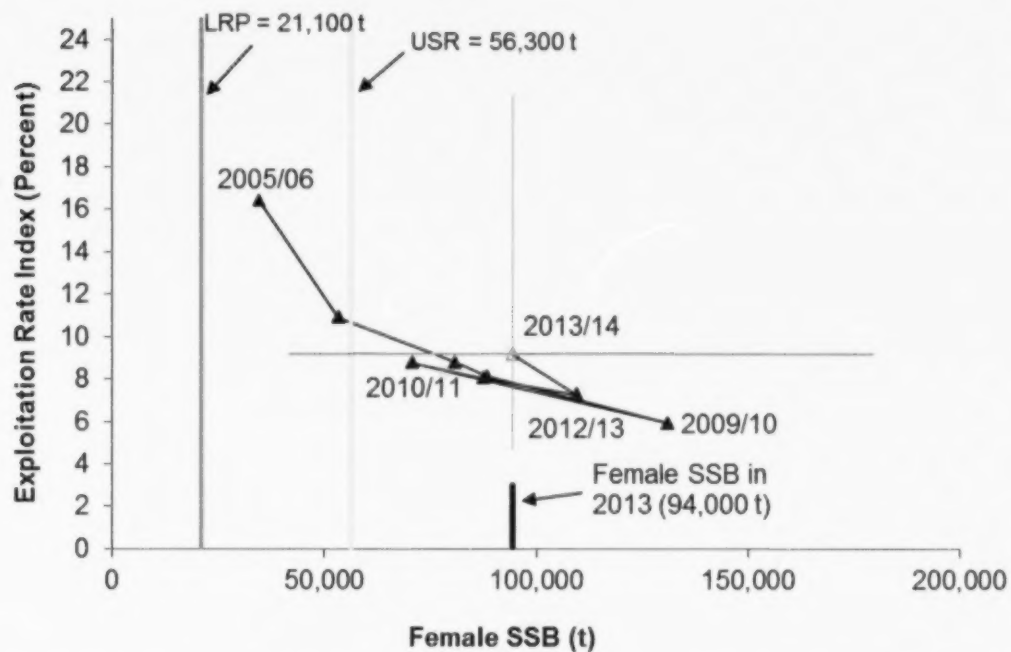


Figure 15. SFA 4 IFMP Precautionary Approach framework with exploitation rate index versus female SSB index. Data point labels denote management year. The 2013/14 fishery was ongoing; therefore the 2013/14 point is preliminary and based on a catch of 13,918 t, 93% of the TAC. The red cross indicates 95% confidence intervals for the fall 2013 female SSB index (horizontal line) and the 2013/14 exploitation rate (vertical line).

Appendix 2: Tables

Table 1. Biomass indices for *Pandalus borealis* in SFA 6.

Fishable Biomass

Survey Year	Lower CI	Index(t)	Upper CI
1996	240 625	315 128	378 960
1997	257 237	309 692	345 232
1998	313 014	359 025	398 290
1999	355 904	411 681	465 343
2000	359 226	416 513	472 391
2001	441 381	520 616	618 276
2002	425 574	491 016	540 048
2003	362 347	432 622	483 264
2004	399 599	454 671	523 133
2005	421 547	505 112	570 252
2006	555 250	669 824	791 445
2007	476 720	566 224	638 613
2008	434 031	509 944	585 555
2009	232 168	310 698	422 957
2010	247 371	295 395	343 117
2011	348 554	408 660	472 290
2012	245 458	316 236	408 660
2013	165 518	212 032	268 111

Female Spawning Stock Biomass

Survey Year	Lower CI	Index (t)	Upper CI
1996	149 006	200 957	243 545
1997	145 583	183 439	211 227
1998	184 446	214 046	240 222
1999	223 006	260 459	297 610
2000	247 673	299 020	338 788
2001	290 764	353 085	424 870
2002	298 315	349 058	385 302
2003	263 580	323 183	366 475
2004	325 498	378 859	436 851
2005	325 599	395 471	450 946
2006	389 128	462 927	541 457
2007	353 286	430 105	493 231
2008	285 327	339 996	407 653
2009	159 477	204 984	276 165
2010	154 342	190 185	222 704
2011	202 266	241 733	283 918
2012	144 979	187 164	228 846
2013	104 204	139 341	181 828

Table 2. Biomass indices for *Pandalus borealis* in SFA 5.**Fishable Biomass**

Survey Year	Lower CI	Index (t)	Upper CI
1996	46 403	86 283	145 080
1997	70 164	101 787	137 428
1998	50 511	70 677	100 781
1999	62 935	90 813	128 669
2000	-	-	-
2001	137 428	183 540	246 867
2002	-	-	-
2003	-	-	-
2004	102 492	150 617	200 555
2005	-	-	-
2006	125 548	155 349	196 024
2007	-	-	-
2008	73 063	128 367	198 440
2009	-	-	-
2010	76 003	144 979	226 832
2011	113 466	144 677	184 446
2012	110 547	147 194	182 533
2013	46 303	75 913	101 083

Female Spawning Stock Biomass

Survey Year	Lower CI	Index (t)	Upper CI
1996	21 868	33 224	47 753
1997	28 553	39 668	50 290
1998	26 851	37 956	50 239
1999	33 506	50 139	69 016
2000	-	-	-
2001	67 174	96 451	129 273
2002	-	-	-
2003	-	-	-
2004	61 928	86 484	110 547
2005	-	-	-
2006	60 851	81 651	106 721
2007	-	-	-
2008	45 457	82 155	126 051
2009	-	-	-
2010	35 701	64 637	99 925
2011	52 797	75 510	103 197
2012	46 373	63 026	79 004
2013	25 663	44 098	59 683

Table 3. Biomass indices for *Pandalus borealis* in SFA 4.**Fishable Biomass**

SurveyYear	Lower CI	Index (t)	Upper CI
2005	29 399	62 321	102 694
2006	45 618	92 424	135 717
2007	72 560	113 970	176 593
2008	74 463	119 004	194 715
2009	94 307	179 512	370 603
2010	59 039	127 058	255 324
2011	71 956	129 777	248 176
2012	122 628	191 393	301 537
2013	65 110	151 221	296 805

Female Spawning Stock Biomass

Survey Year	Lower CI	Index (t)	Upper CI
2005	17 186	34 533	52 807
2006	30 597	53 360	72 832
2007	54 297	80 846	121 219
2008	53 058	88 296	157 262
2009	66 831	130 985	272 339
2010	28 825	70 879	150 013
2011	57 478	87 491	147 798
2012	75 913	109 540	164 813
2013	41 611	94 337	179 412

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